

# HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

**Hatchery Program:**

LUMMI NATION COHO

**Species or  
Hatchery Stock:**

NOOKSACK HATCHERY COHO

**Agency/Operator:**

LUMMI INDIAN NATION

**Watershed and Region:**

WRIA 1, WHATCOM COUNTY  
NOOKSACK RIVER, LUMMI BAY,

**Date Submitted:**

March 17, 2003

**Date Last Updated:**

March 17, 2003

## SECTION 1. GENERAL PROGRAM DESCRIPTION

### 1.1) Name of hatchery or program.

Lummi Nation Hatchery Coho Program, Skookum Creek Hatchery, Lummi Bay Hatchery

### 1.2) Species and population (or stock) under propagation, and ESA status.

Coho salmon: Nooksack Hatchery Stock (*Oncorhynchus kisutch*).

ESA Status: Candidate, Not Listed

### 1.3) Responsible organization and individuals

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#### Skookum Creek Facility

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### Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Agency	Involvement
WA Dept. Fish & Wildlife (WDFW)	co-manager
Nooksack Tribe	co-manager
US Department of Interior	primary funding agency

#### **1.4) Funding source, staffing level, and annual hatchery program operational costs.**

Hatcheries are funded through the, Lummi Indian Nation, Natural Resources Program, which receives its funding from the US Department of Interior.

##### **Skookum Creek**

There are three full-time staff at the Skookum Creek Facility. Two employees and their families live on the hatchery site. The hatchery is staffed 24 hours a day, 7 days a week. Annual operational costs at Skookum Creek Hatchery are approximately \$215,000, all dedicated to Coho

##### **Lummi Bay Hatchery**

There are four permanent full time, and one seasonal full time staff are at the Lummi Bay Facility. Lummi Bay Hatchery is located on reservation and is equipped with alarm systems at all critical control points which contact staff upon system failure. There are on-call staff available 24 hours a day, 7 days a week. The Lummi Bay Hatchery annual hatchery operational costs are approximately \$250,000 with \$90,000, allocated to Coho at the Lummi Bay Facility.

#### **1.5) Location(s) of hatchery and associated facilities.**

##### **Skookum Creek Facility:**

South Fork Nooksack River, RM 14.3, Nooksack River Basin,, WRIA 1, just downstream of the confluence with Skookum Creek (Exhibit 1).

Lummi Bay Complex: Lummi Bay, Southeast Georgia Strait, Nooksack River Basin, WRIA 1, Sections 8,9,10; TWN 38N; Range 1E.

#### **1.6) Type of program.**

##### **Coho salmon: Integrated/Segregated Harvest**

The status of the natural origin fish is not clearly understood due to past hatchery practices, and degradation of habitat in the watershed. Recent genetic work suggests that there are coho in the upper North Fork watershed that spawn earlier than the cultured stocks.

#### **1.7) Purpose (Goal) of program.**

The goal of the program is to efficiently produce adult coho salmon allowing a harvestable surplus to support Treaty Right fisheries in North Bellingham Bay and the Nooksack River, in and around the Lummi Reservation in accordance with the best available science and in a manner that will not to impede the recovery of ESA listed species. Program production also mitigates for coho production lost through habitat degradation in the region since treaty times, provides additional harvest opportunity for other fishers in the Bellingham/Samish Bay terminal area, and supports production obligations under the Pacific Salmon Treaty. The Pacific Salmon Treaty provides for treaty right fisheries on Fraser River sockeye and pink stocks in the vicinity of the reservation that are economically and culturally important to the tribal fishers.

### 1.8) Justification for the program.

This program provides tribal harvest opportunities pursuant to rights reserved in the Treaty of Point Elliott which, absent a hatchery program, would have been lost due to habitat degradation associated with development in the Nooksack Watershed and the shorelines of Bellingham Bay and Southeast Georgia Strait. This will be objective will be accomplished while minimizing the adverse effects on listed fish.

### 1.9; 1.10) List of program "Performance Standards" and "Performance Indicators".

#### SUMMARY STANDARDS, INDICATORS, AND MONITORING PLAN

Performance Standard	Performance Indicator	Monitoring and Evaluation Plan
Contribution to all fisheries with an emphasis on the contributions to the Lummi fisheries adjacent to the Reservation.	Numbers contributed to Fisheries	Recover, compute and report CWT per Co-Manager guidelines, with special attention to fisheries adjacent to the reservation.
Incidental catch of listed fish in coho fisheries less than 1% of total catch	Catch of listed chinook in coho fisheries	Estimate chinook contribution from sampled catch through CWTs, otolith or genetic identification.
Meet Hatchery Brood Stock Goals: SC 800-1000 or each sex LB 800-1000 or each sex	Fish Returning to hatchery	Count fish returning to the facility by sex and age in an manner to reflect time of return.
Meet Hatchery Production Goal of 1 million smolts from each facility	Smolt Release Numbers	Estimate of Numbers just prior to release
Maintain stock integrity and genetic diversity	Follow spawning guidelines	Record of spawning activities
Maximize production efficiencies through survival of brood stock and their progeny	Monitor changes in populations held and conditions experienced	Evaluate conditions associated with changes in monitored stocks and change as required.
	Monitor fish health, recommend preventative actions and strategies to maintain fish health.	Fish Health Monitoring records
Minimize interactions with listed fish.	Disease incidence frequency and type meets Co-Manager Disease Policy	Fish health monitoring records
	Co-Occurrence during Peak Hatchery Coho Out-Migration	Monitor coho adipose clip ratio in South Fork and lower mainstem smolt traps
	Co-Occurrence of hatchery coho and listed juvenile chinook in freshwater	Research studies to determine extent of juvenile co-occurrence in freshwater

	Co-Occurrence of Hatchery Coho and listed juvenile chinook in near-shore marine	Research studies to determine magnitude of juvenile co-occurrence in estuary and near-shore marine areas
	Predation of hatchery coho on listed chinook.	Examine coho stomach contents.
Ensure hatchery operations comply with state and federal water quality standards through proper environmental monitoring		

**1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).**

Nooksack Hatchery coho.

Skookum Creek - 800- 1,000 females and 800-1,000 males

Lummi Bay: 800-1,000 females and 800-1,000 males

**1.11.2) Table 1. Proposed annual fish release levels (maximum number) by life stage and location:**

Life Stage	Release Location	Annual Release Level
Eyed Eggs	-	0
Unfed Fry	-	0
Fry	-	0
Fingerling	-	0
Yearling	South Fork Nooksack	1,000,000
	Lummi Bay	1,000,000

**1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.**

**Program performance indices for Lummi Coho Program. Jacks are not included among returnees.**

**Lummi Bay**

Return Year	Smolts (Release Year)	Total Adults	Hatchery Rack	% Survival
1991			2258	
1992			20847	
1993	758432 (1995)		8005	3.25
1994	1320000 (1997)		3497	3.97
1995	1500000		7034	1.99
1996	1,049,000 (1995)		4913	2.11
1997	897,700 (1996)		4811	1.62
1998	1,218,448 (1997)		4127	1.10
1999	1,014,517 (1998)		8774	1.61
2000	994,782(1999)		15665	0.79
2001	947,700(2000)		4636	2.58
2002	820,700(2001)			

**Skookum Creek**

Return Year	Smolts (Release Year)	Total Adults	Hatchery Rack	% Survival
1991			2338	
1992			5638	
1993	1350000(1992)		5815	3.09
1994	1800000(1993)		2255	4.70
1995	1900000(1994)		15728	3.43
1996	1,751,000 (1995)		10351	3.75
1997	1,003,771 (1996)		14579	1.93
1998	1,050,952 (1997)		8619	1.03
1999	721,537 (1998)		9139	1.98
2000	1,650,000 (1999)		33818	1.94
2001	1,149,200 (2000)		19756	4.45
2002	757,357 (2001)			

**1.13) Date program started (years in operation), or is expected to start.**

The Skookum Creek coho program began in 1977 and has operated continuously since that date

The Lummi Bay coho program began in 1971 and has operated continuously since that date.

**1.14) Expected duration of program.**

The hatchery program is expected to continue as long as hatchery production is needed to sustain Treaty Right fisheries and does not impede the recovery of listed species.

**1.15) Watersheds targeted by program.**

Nooksack River, WRIA 1

**1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.**

This hatchery program was initiated to provide sustainable fisheries in an area historic fisheries and highly degraded habitat would no longer support naturally spawning populations. The Lummi Nation has participated vigorously in programs to restore properly functioning conditions to all salmonid streams in WRIA 1. A recovery strategy was developed to reduce the terminal harvest rate to a level that would allow the straying of hatchery coho to any suitable habitat that might be underseeded as there was no evidence of a native stock in the watershed. The strategy was dropped pursuant to co-manager agreement to reduce coho production and to address the effect of this strategy on ESA listings.

**SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID**

**POPULATIONS. 2.1) List all ESA permits or authorizations in hand for this hatchery program.**

There are no ESA permits for this program at the present time.

**2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.**

**2.2.1) Description of ESA-listed salmonid population(s) affected by the program.**

Five indigenous stocks in the Nooksack Watershed are components of ESUs (NOAAF) or DPS (USFWS) listed as Threatened under the ESA. The stock components are: North Fork Nooksack chinook, South Fork Nooksack chinook (WDF, et.al. 1993), and three bull trout/Dolly Varden stocks (WDFW 1998).

The two listed chinook stocks are genetically distinct from each other (Marshall et al. 1995, Myers et al. 1998).

The North Fork stock is genetically more similar to Fraser River strains than to the South Fork Nooksack stock (Meyers et al. 1998). This genetic pattern may be the result of the separation of the two forks into independent watersheds during the late Pleistocene Era. During the Pleistocene, glaciations, and a massively dynamic Fraser River, made many changes to the present day Nooksack, Samish, and Skagit drainages (Butler and Campbell 1987, Skagit County 1995). At an interval in this epoch, the North Fork may have been a tributary to the Chilliwack River and the South Fork a tributary to the Samish River (Easterbrook 1971).

Limited field data indicate the North Fork Nooksack chinook is also the stock that utilizes the Middle Fork Nooksack River (WDFW and WWTT 1994).

*Life History.* The fish enter the river between March and August with peaks in May and June. Their upriver migration is slow often taking more than a month to reach the confluence of the North and South Forks. The North Fork chinook spawn earlier than the South Fork stock. The main redd construction period is September 2 to September 21 (Marshall et al. 1995).

Based on smolt trap scale sampling from 1980- 1983, the North Fork stocks have a tendency to out-migrate as sub-yearlings (Marshall et al. 1995).

Natural-spawning population estimates and run timing are based largely on carcass counts

#### North Fork Chinook

The North Fork Nooksack chinook's utilization stream tributaries for spawning underscores the importance of protecting and restoring these habitats. Currently, habitat conditions are highly degraded in Boulder, Canyon, Deadhorse, Glacier, Racehorse and Wells Creeks (Zander 1966, USFS 1995, FERC 1997). Indeed, the majority of feeder streams to the North Fork have experienced extensive logging and road building in their watersheds, resulting in documented instances of mass wasting and debris torrents (Zander 1966, USFS 1995, FERC 1997). Additionally, extensive home building has taken place on the highly unstable alluvial fans of Canyon, Glacier, and Boulder Creeks. Aside from the direct impacts these settlements have had on riparian habitats, they have also necessitated stream bank armoring with diking, rip rap and other materials to protect human life and property. Landowners are currently requesting additional diking be constructed on Canyon Creek to protect homes (The Bellingham Herald, March 19, 2000).

Habitat degradation and associated reduced habitat carrying capacity at incubation, and rearing habitats, is a chief impediment to recovery of a naturally-spawning populations of North Fork Nooksack chinook.

South Fork Nooksack Chinook. The South Fork chinook is not closely related either to the North Fork Nooksack stock or to other chinook in adjacent river basins (Meyers et al. 1998, Shacklee and Young 1999). This stock has several life history traits that diverge from those of the North Fork Nooksack chinook. They spawn later in the summer. The main redd construction period is September 19 to September 29 (Marshall et al. 1995).

Based on limited data the South Fork stock also shows a tendency to outmigrate as yearlings (Marshall et al. 1995, BRT 1996), in contrast to North Fork. The longer fresh water residence pattern is thought to be inherited for chinook, generally, but BRT 1996 speculates that the characteristic may be suppressed by habitat conditions in the South Fork stock. Recent investigation of the data for the South Fork suggests a

much lower percentage of the returning run left the river as yearlings. The South Fork, in contrast to the North Fork, is not fed by glaciers.

Canyon Creek bull trout/Dolly Varden. Canyon Creek is a tributary to the North Fork Nooksack River. It is a deeply incised, high gradient stream 15.1 miles long (Williams et al. 1975, FERC 1997). One-time genetic sampling in 1995 distinguished the Canyon Creek stock from the other Nooksack bull trout/Dolly Varden stocks, in that, only Dolly Varden genetic material was isolated (WDFW 1998). SASSI (WDFW 1998) and the U.S. Fish and Wildlife Service classify the status of the Canyon Creek bull trout/ Dolly Varden stock as “Unknown”. Additional research on this stock is urgently needed.

Upper Middle Fork Nooksack bull trout/Dolly Varden. This stock is identified on the basis of genetic isolation from all other stocks in the greater Nooksack Basin, as the result of the construction of water diversion dam in 1962 on the Middle Fork Nooksack (RM 7.3) that blocks all upstream fish passage. The diversion is owned and operated by the City of Bellingham to supply municipal water uses. The diversion isolates over 20 miles of potential habitat from anadromous use (*sensu* Williams et al. 1975, WDFW 1996). SASSI (WDFW 1998) and the U.S. Fish and Wildlife Service classify the status of the Upper Middle Fork Nooksack bull trout/ Dolly Varden stock as “Unknown”. The population has not been studied genetically or otherwise.

Lower Nooksack bull trout/Dolly Varden. This stock includes those bull trout/Dolly Varden breeding at other locations in the Nooksack drainage, excluding Canyon Creek and the Upper Middle Fork. The stock is known to spawn in the North, South, and lower Middle forks of the Nooksack, and to use the mainstem for migration (WDFW 1998). An historical resident population occurs above the impassible barrier Nooksack falls (Mongillo 1993). Use of the mainstem Nooksack and independent drainages for spawning has not been documented (Mongillo 1993). Life forms include resident (e.g. above Nooksack Falls on the NF), anadromous, and unknown (Mongillo 1993).

**-- Identify the ESA-listed population(s) that will be directly affected by the program.**

There are no listed species currently integrated, or directly affected by, operations at Skookum Creek Hatchery or the Lummi Bay Facility.

**- Identify the ESA-listed population(s) that may be incidentally affected by the program.**

Potential incidental interactions with the South Fork and North Fork/Middle Fork chinook stock would be related to possible predation interactions between juvenile out-migrant coho and fry or juvenile chinook. To a lesser extent, this predation may also be a concern for out-migrant North Fork chinook.

Based on smolt trap data reported in MacKay, 2000 and collected for the years 1994-2002, a preponderance of coho out-migration through the lower river (more than 90%

in most years) takes place within a two- to three- week period in mid-May. The out-migration of juvenile chinook, on the other hand, was much more evenly distributed over a several month period. In most of the years (1994-1999) the occurrence of juvenile chinook in smolt trap samples during the identical periods used by coho was quite low (<1 %). There were, however, substantial portions of the total chinook out-migration in two of the years (ca 35%). An additional smolt trapping operation was established near the mouth of the South Fork in 2000. Data from both traps will help to document possibilities for negative interactions between juveniles. At present we do not have adequate data available on co-occurrence of coho and chinook juveniles in the South Fork or other portions of the watershed with which to evaluate the degree of concern for negative interaction.

We have taken what we believe to be prudent steps to substantially reduce negative interactions between coho produced in this program and listed species. The Lummi Coho Program reduced the production goal identified in the co-manager's Equilibrium Brood program from 6,000,000 yearlings to 2,000,000 yearlings. Of the 2,000,000 production goal, 1,000,000 are presently programmed for release in Lummi Bay and 1,000,000 are programmed for release into the South Fork. These changes are in addition to a reduction from approximate 5,000,000 coho releases to 350,000 for the WDFW Nooksack Hatchery on Kendall Creek. These changes were made based on a review of the potential for yearling coho to prey upon juvenile chinook according to studies conducted in the Columbia River and on the Fraser River areas. At present there is no data concerning predation of program coho on juvenile chinook or Bull Trout in the Nooksack River.

Potential interactions between Canyon Creek and Middle Fork bull trout and coho produced under this plan are limited to potential intermingling in near-shore marine and estuarine habitats. This has not been documented. The potential for negative interactions between the Lower Nooksack bull trout and Skookum/Lummi Bay coho may be somewhat higher than for the other bull trout stocks. Potential interactions may involve spawning area competition and predation in the South Fork, lower mainstem tributaries, estuarine, and near-shore marine areas. There is little or no data to support the impact of these potential interactions.

#### **2.2.2) Status of ESA-listed salmonid population(s) affected by the program.**

- Describe the status of the listed natural population(s) relative to “critical” and “viable” population thresholds .**

Critical/Viable population thresholds under ESA have not been established yet. SASSI (WDF, WDW, WWTT, 1993) placed a Critical classification on North and South Fork Chinook stocks and an Unknown classification on Nooksack-origin Bull Trout.

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.**

Adult to adult replacement for North Fork chinook naturally spawning early chinook has been consistently less than one, averaging about 0.3. The listed North Fork Chinook hatchery stock has increased. Replacement of the South Fork naturally spawning stock has averaged about one since 1988.

**Provide the most recent annual spawning abundance estimates [of naturally spawning fish], or any other abundance information**

**North Fork/Middle Fork Chinook Stocks**

<b>Brood Year</b>	<b>Natural Spawners</b>	<b>Cultured Spawners Volunteer/Turn-Backs</b>	<b>Natural Origin Spawners</b>
<b>1990</b>	10		
<b>1991</b>	107		
<b>1992</b>	493		
<b>1993</b>	445		
<b>1994</b>	45		
<b>1995</b>	230	59	171
<b>1996</b>	535	326	209
<b>1997</b>	617	546	74
<b>1998</b>	370	327	37
<b>1999</b>	823	738	85
<b>2000</b>	1242	1082	160
<b>2001</b>	2185	1878	264
<b>2002</b>	3741	3517	224

**South Fork Chinook**

<b>Return Year</b>	<b>South Fork Stock</b>	<b>Early Strays (North Fork)</b>	<b>Total Early</b>
<b>1995</b>			290
<b>1996</b>			203
<b>1997</b>			180
<b>1998</b>			157
<b>1999</b>	164	126	290
<b>2000</b>	283	89	372
<b>2001</b>	268	152	420
<b>2002</b>	282	338	620

**-Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.**

Refer to the above tables.

**2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take.**

**- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.**

The intake structure in Skookum Creek for the Hatchery Substantial might possibly obstruct the movement of listed fish in and out of the Skookum Creek drainage. The use of this watershed by listed species has not been quantified. Modifications to the intake structure to include a fish ladder are designed, funded and waiting on the submission of the Environmental Assessment and the necessary permits. The hatchery is dependent on a continuous water supply from the creek to sustain fry and rearing ponds.

Monitoring activities which may take listed species have been detailed in the HGMP for the Lummi Bay Chinook Program:

- Spawning ground surveys in the South Fork could disturb spawning fish and damage redds, but operational protocols require special attention by the surveyors to avoid stepping in the area of redds or disturbing spawning fish. Any coho surveys will be done by the same surveyors who will know to avoid the areas of marked redds.
- Smolt Trap Operations follow protocols to minimize trauma to captured fish. From 1996, the third year of operations, lower river trap, experienced a range of 0.2% to 0.4% of the chinook handled, and it is estimated that the trap captures between 2% and 6% of the chinook passing the trapping site.
- Juvenile survey work - The juvenile survey work will follow the same handling protocols developed for the trap operations. While the operations have been on a limited scale in the past, we have no record of mortalities. The effect of any mortality from this work is no known.

**-- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.**

One incident of direct take of a listed species is known to have occurred in recent years at Skookum Creek Hatchery. In 1998, an unmarked female chinook entered the spawning pens. She was released uninjured and did not return. Run timing would indicate that this female was a stray fall chinook stock, and likely hatchery reared as adipose fin marking was not universal at the time.

**- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).**

There is not enough data currently available to estimate the potential take of listed species nor to identify the limiting factors in the production of listed species. Research coordinated with the Co-managers and NOAA Fisheries will be implemented as resources will allow to develop information required to estimate the amount of take that might be associated with the hatchery program through predation of listed fish, competition for spawning by areas by straying hatchery coho, competition for habitat and food in the river, estuary and near shore and pelagic ocean areas, and predation by hatchery coho on listed species.

**-Estimated listed salmonid take levels of by hatchery activity.**

. Not applicable. Listed fish not taken into hatchery

**- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.**

All incidence of take will be reported to the National Marine Fisheries Service and/or the U. S. Fish and Wildlife Service to determined the modifications in the plan that may be required.

### **SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES**

**3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review Report and Recommendations* - NPPC document 99-15). Explain any proposed deviations from the plan or policies.**

There is currently no coordinated regional hatchery plan. A Puget Sound Regional Hatchery Management Plan is being developed

**3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.**

This program is operated under the Puget Sound Salmon Management Plan and its Equilibrium Brood Document and Future Brood Document. The Co-Managers draft RECOVERY PLAN FOR CHINOOK SALMON IN WRIA 1, THE NOOKSACK BASIN contains the current agreements modifying the Equilibrium Brood Document of 1993.

**3.3) Relationship to harvest objectives.**

*Explain whether artificial production and harvest management have been integrated to provide as many benefits and as few biological risks as possible to the listed species. Reference any harvest plan that describes measures applied to integrate the program with harvest management.*

**3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.**

The Lummi Hatchery Program Coho contributes to the harvest on the West Coast Vancouver Island, Strait of Georgia, Washington Coastal and Puget Sound commercial and sport fisheries in addition to its predominance in the Bellingham Bay and Nooksack River terminal area tribal and commercial, sport and subsistence fisheries.

**3.4) Relationship to habitat protection and recovery strategies.**

The Lummi Coho Program, as part Co-Managers draft RECOVERY PLAN FOR CHINOOK SALMON IN WRIA 1, THE NOOKSACK BASIN, made the following changes in the program as set out in the 1993 Equilibrium Brood Document. Off station fry plants of 1,000,000 annually were eliminated, as was the production of 250,000 yearlings for the Bellingham Bay net pens. Skookum creek annual smolt release objective was reduced from 2,000,000 to 1,000,000 and the Lummi Bay annual smolt release objective was similarly reduced from 2,000,000 to 1,000,000.

**3.5) Ecological interactions.**

*Describe salmonid and non-salmonid fishes or other species that could (1) negatively impact program; (2) be negatively impacted by program; (3) positively impact program; and (4) be positively impacted by program. Give most attention to interactions between listed and "candidate" salmonids and program fish.*

Ecological interactions of program fish on listed and candidate species might include competition or predation. While there are some adverse impacts on the program efficiency from bird and mammal predation on the fish reared at the hatchery, they have not been a major impact on the operation. While there has been speculation that there might be predation by smolts released at the Skookum Creek hatchery and newly emergent listed chinook fry. Preliminary research investigating the stomach contents of hatchery and natural coho at the Lower River smolt trap has not produced any indication of fish predation, even in the presence of small pink and chum fry which would be comparable to the emergent chinook fry. The Skookum Creek coho production is released as smolts to minimize freshwater residence time, which reduce any opportunity for predation and competition.

We are not aware of studies characterizing the diets and habitat preferences of hatchery coho, natural coho and listed chinook or other salmonids in the fluvial, estuarine or marine environments in a manner that would allow a determination of predation or competition that might exist between hatchery production and listed and candidate species.

In any case, the substantial reduction in production from the Lummi Hatchery Coho program

should significantly reduce any potential adverse interactions relative to the original production levels of the early 90s

Lummi is developing and implementing research projects to investigate interspecies competition and predation issues as resources can be identified.

## **SECTION 4. WATER SOURCE**

### **4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.**

#### **Skookum Creek Hatchery**

Skookum Creek Hatchery derives its water from two sources. The primary source is a diversion weir on Skookum Creek approximately 1,000 feet above the creek's confluence with the South Fork. There is an existing state water right permit (WDOE #22899, 1983) to withdraw 40 cfs or 1795 gpm. Under the permit, minimum flows for Skookum Creek are 26 cfs. Water quality from Skookum Creek is generally excellent with low mineral and nitrate content. Water flows from the diversion structure by gravity to a settling ponds and the raceways and rearing and acclimation ponds. Incoming temperatures range from 32 to 60° F. The facility also receives water from 5 drilled wells that can supply 350 gpm. The well water is insufficient in volume and high in iron and sulfur content. Well water is preferred for egg incubation. Fry are rear in Skookum Creek water from April until their release over a year later. In the fall and spring the Skookum Creek water is muddy as a result of watershed activities and makes feeding fish difficult. Low flows can be a problem in August and September.

Lummi in coordination with the Bureau of Reclamation, BIA and WDFW have the resources assembled to stabilize the stream channel near the diversion, install a fish ladder near the diversion and protect the line from the diversion to the hatchery. The design has been completed, the funding has been identified and the appropriate permits are in process.

Water is continuously passed through incubation trays and rearing ponds, and under routine operation exits the hatchery untreated through the main raceway leading to the South Fork Nooksack.

#### **Lummi Bay Facility**

Nooksack River surface water is pumped from Kwina Slough through a pipeline to a reservoir and settling pond (100' x 100' x 5') on Chief Martin Road and then fed to the Lummi Bay facility through a gravity line. The current water supply is limited to 1050 gpm. Low flows and silting of the slough have severely limited the availability of water when needed. The river water has a high silt load at the best of times.

Lummi is in the final stage of relocating the pump station from Kwina Slough to the main river to ensure a more reliable water supply to the facility. Funding has been identified,

designs have been completed, a pipeline extension has been installed, and permits for the final stage of construction are in process.

Water intake structures located near the Southeast tide gate of the sea pond pump water at 750 gpm when required to condition smolts prior to release.

Eggs are incubated at an auxiliary facility at Sandy Point on Lummi Bay. Water is provided from a well to a 25,000 gallon storage tank. The flow to the incubation facility is gravity fed.

**4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.**

**Skookum Creek**

Screens at the intake at Skookum Creek conform to WDFW screening guidelines (1998) for avoiding entrainment of juvenile fish. Waste water generated during cleaning of drained ponds is routed to two earthen retention ponds where it passively percolates into the soil or evaporates. Hatchery effluent is monitored according to the 1972 NPDES permit requirements and will comply with all EPA requirements.

The reorganization of the intake structure will incorporate NOAA fisheries screening requirements and improve that access of listed fish above the existing structure which has been adversely impacted by high levels of transport associated with logging activities in the Skookum Creek

**Lummi Bay Facility**

The screens on the Kwina Slough Pump Station meet current WDFW screening requirements. The new Nooksack River Pump Station to be operational by September 2004, will have NOAA Fisheries intake screens. Sea water pump intakes are screened to prevent the entrainment of juvenile fish.

## **SECTION 5. FACILITIES**

**5.1) Broodstock collection and holding facilities (or methods).**

**Skookum Creek**

Returning adults enter the Hatchery grounds through a channel leading to a fish ladder that leads to a 50' x 70' concrete holding pond, with a system of wooden panels and gates that aid in the processing of the adults entering the facility. It also serves as a temporary holding facility.

**Lummi Bay Facility**

All coho collected for brood stock are selected from adults that voluntarily enter a fishway through the southeast tide gate of the sea pond connecting to a 40' x 40' concrete trap and pond fitted with fencing panels to ease the processing of the accumulated fish. Brood stock is composed of adults selected proportionally over the adult entry period. Selected adults are transported in totes with water enriched with compressed oxygen to one of the 4, 40' diameter circular concrete holding ponds at the hatchery facility 1/4-mile away.

## **5.2) Fish transportation equipment (description of pen, tank truck, or container used).**

Skookum Creek:

There is no transportation of adult fish at this facility. Brood stock is sorted over the panels in the collection facility and move into a holding pond. Green eggs are transported by bucket a short distance to the incubation facility. Fry are transported to concrete fry raceways until they are ready for tagging or fin clipping. From the tagging trailers the fry are carried by a system of pipes to the rearing ponds.

Lummi Bay

Unfertilized eggs and milt collected from the brood stock at the Lummi Bay Facility are transported from the to the Sandy Point Incubation facility in five gallon buckets. Where they are fertilized and placed into incubators. When the eggs are eyed, they are transported to Skookum Creek Hatchery in five gallon buckets for placement in incubators for hatching, fry rearing, marking and tagging fingerling rearing in the same fashion as the Skookum Creek production. Through out their time at Skookum Creek, the Lummi Bay production is kept in separate facilities to prevent any potential cross contamination.

When the Lummi Bay smolts reared at the Skookum Creek Facility easily survive a sea water challenge, they are transported to Lummi Bay at appropriate loading densities in a 1,000 gallon aluminum tank with a circulating pump mounted on a flat bed truck. The trip to Lummi Bay takes approximately 50 minutes.

## **5.3 Broodstock spawning facilities.**

Skookum Creek.

The spawning shed is a pole structure located adjacent to the broodstock collection pond. Equipment includes a single stainless steel processing table, plastic totes for killing (by CO<sub>2</sub> asphyxiation) and discarding fish, and various nets and tools. Efficient design allows all spawning activities to be handled by as few as two people.

Lummi Bay

A spawning shed is located adjacent to four 40' diameter circular concrete holding ponds. Brood stock are sorted into the holding ponds segregated by sex, and held until ripened (one

to one and one-half months).

#### **5.4) Incubation facilities.**

##### **Skookum Creek**

The incubation facility is a house separately from rearing and spawning facilities; it has two separate rooms with independent plumbing and equipment to avoid the risk of cross contamination from Lummi Bay fish. Two rooms allows complete separation of egg stocks, ensuring that no cross contamination by disease can occur between stocks of different origin. Lummi Bay Sea Pond eggs are kept in a separate cycle from Skookum Creek Hatchery spawned eggs.

Each room has nine NoPad™ incubating trays that can hold 320,000 green eggs. When eggs are initially placed, they are treated with a dilute iodine solution to “harden” the egg wall and reduce disease occurrence. Well water is circulated through the trays and exits below. When eggs are eyed, a mesh substrate is placed in the tray to provide hiding cover for alevins.

At Lummi Seaponds, incubation is at the Sandy Point Incubation facility. This facility is equipped with eight (8) NoPad, total capacity 1.5 million eggs, supplied with a minimum of 40 g.p.m. of well water. Eyed eggs are transported to the Skookum Creek hatchery for hatching and subsequent rearing.

#### **5.5) Rearing facilities.**

##### **Skookum Creek**

All eggs from both Skookum Creek and Lummi Bay are incubated and hatched in separate facilities at Skookum Creek. “Buttoned up” coho fry are weighed (approx. 1,600-2,100/lb) and transferred from the incubation facility to one of twelve 22,642 gallon concrete raceway rearing pens. Each raceway has 2,316 cu. feet rearing space and can hold 175,000 fry. Fry are fed at the rate of 2% feed per body weight per day. At 250 to 300 fish/lb., fingerlings are marked and/or CWT and marked with an adipose fin clip, and are transferred to one of four 50' x 325' asphalt lined rearing and acclimation ponds holding approximately 10,900 gallons of water.

#### **5.6) Acclimation/release facilities.**

##### **Skookum Creek**

The production from the Skookum Creek brood is held in one of four 50' x 325' asphalt lined rearing and acclimation ponds holding approximately 10,900 gallons of water until their release into the South Fork of the Nooksack

The smolt production of the Lummi Bay brood stock, incubated and reared in separate facilities at Skookum Creek is until the smallest of them easily survive a sea water challenge, they are transported to Lummi Bay at appropriate loading densities in a 1,000 gallon

aluminum tank with a circulating pump mounted on a flat bed truck. The trip to Lummi Bay takes approximately 50 minutes. The coho are then contained in net enclosures in the southeast corner of the Lummi Bay Sea Pond until they reach 20 per pound.

**5.7) Describe operational difficulties or disasters that led to significant fish mortality.**

In the early spring of 1988, Viral Hemolytic Septicemia Virus (VHSV) was detected in coho broodstock at the Lummi Bay Hatchery. VHSV, as it was known then, was a lethal viral disease that is commonly transmitted through water. At that time, it was thought that VHSV could also be transmitted vertically—from breeders to offspring. As a precaution to prevent further disease spread, all eggs and rearing fry at the Lummi Bay facility were destroyed and all rearing structures were sterilized with a strong chlorine solution.

Unfortunately, just prior to detecting the disease, eggs had been transferred from the Sea Ponds to Skookum Creek Hatchery. At that time water was shared among broods of all origins, thus the potential for disease cross contamination was real. Under advice from the fish pathologist at Northwest Indian Fisheries Commission, all coho eggs and fry were destroyed at the Skookum facility as well. The entire Lummi coho crop for 1989 was lost; a total of over 7,000,000 fish. Subsequent research has failed to confirm vertical transmission or virulence in Pacific salmon. It is unlikely that blanket destruction will again be necessary. Skookum Creek

Two outbreaks of “Cold Water Disease” have occurred at the Skookum Creek Hatchery in recent years. This is a bacterial disease that occurs when water temperatures drop below 50° F. Affected fish are treated with tetracycline-medicated feed. Outbreaks have resulted in low levels of fry mortality and some growth retardation.

In approximately 1987, a spawning pen gate failed and pen water dropped suddenly. About 500 coho spawners died as a result.

**5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.**

All of the fish that enter the hatchery are examined for marks and tags that would identify them as hatchery or natural origin production. No natural origin fish are taken into the hatchery population. While Puget Sound coho have been identified as a candidate species by NOAA Fisheries, the status of the native and natural origin stocks in the Nooksack basin is unknown and under investigation.

Facilities are all located in areas not subjected to flood events. A fish health specialist regularly monitors the health of fish in held in the facilities and prescribes minimum loss to minimize loss and avoid transmission to natural origin fish in the watershed. Hatchery discharge is monitored according to NPDES permits.

## **SECTION 6. BROODSTOCK ORIGIN AND IDENTITY**

**Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.**

### **6.1) Source**

Brood stock at each facility is selected from volunteer coho entering the trapping facilities on site. All of the fish that enter the hatchery are examined for marks and tags that would identify them as hatchery or natural origin production. No natural origin fish are taken into the hatchery population. While Puget Sound coho have been identified as a candidate species by NOAA Fisheries, the status of the native and natural origin stocks in the Nooksack basin is unknown and under investigation.

### **,6.2) Supporting Information**

#### **6.2.1) History**

Many out-of-basin coho stocks have been used to build and maintain the coho broodstock at Skookum Creek Hatchery. Until recent times, it was common practice among hatchery managers in the Puget Sound to exchange and mix stocks with few restrictions. Unfortunately, record keeping was uneven and the details of stock origins and numbers. There is no need to record the history prior to 1989 when the entire production of Skookum Creek and Lummi Bay were destroyed as a precautionary measure in response to VHSV detection. While Puget Sound coho have been identified as a candidate species by NOAA Fisheries, the status of the native and natural origin stocks in the Nooksack basin is unknown and under investigation.

After the destruction of the 1987 and 1988 broods of coho at the Skookum Creek and Lummi Bay facilities, transfers of yearlings and eggs from similar Green River derived stocks coho from hatcheries in Northern Puget Sound. Since that time, with the exception of an additional intake of fingerlings surplus to the Kendall Creek program during their program reduction in \_\_\_\_\_, brood stock entering the facilities has been sufficient to meet production objectives.

#### **6.2.2) Annual size.**

Annual collection goals at each facility are 800 to 1000 males and 800 to 1000 females.

#### **6.2.3) Past and proposed level of natural fish in broodstock.**

The Skookum Creek/Lummi Bay coho program is managed to collect only hatchery-origin broodstock. All hatchery fish are adipose fin clipped. There is no future plan to supplement hatchery stock with natural-origin stock. Unmarked spawners are assumed to be wild. Unmarked coho will be released to the river.

#### **6.2.4) Genetic or ecological differences.**

Because of the long history of hatchery production in the Nooksack Basin, and the degraded nature of the coho habitat in the basin and attempts to use hatchery fry to stock potential coho habitat, the status of a native stock in the Nooksack Basin is unclear. Recent microsatellite DNA analysis suggests that coho in all areas of the basin down stream of the Kendall Hatchery are indistinguishable regardless of location sampled, but distinguishable from naturally spawning coho in the areas upstream of the WDFW Kendall Creek facility. Virtually nothing is known at this juncture of any differences in genotype, phenotype, or behavior between hatchery stocks and naturally spawning coho (M. F. Small WDFW ms.)

#### **6.2.5) Reasons for choosing.**

The success of the Green River/Soos Creek derived coho stocks in Northern Puget Sound watersheds is well documented. The use of the returning adult production from the facilities is intended to maintain a healthy population and reduce straying potential.

#### **6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.**

The risk of infusion of non-native, non-adapted genomes into Nooksack wild coho will be reduced by avoiding any new introductions of out-of-basin stocks.

## **SECTION 7. BROODSTOCK**

#### **7.1) Life-history stage to be collected (adults, eggs, or juveniles).**

Both facilities select brood stock from adults returning to on site traps.

#### **7.2) Collection or sampling design.**

At Skookum Creek, broodstock are selected from fish that have entered the hatchery grounds through the channel between the brood stock collection pond and the river. They swim through a fish ladder to the pond with wooden panels that can be arranged to facilitate processing of the returning fish. Male and female spawners are selected in numbers relative to the numbers of fish entering the pond and the total expected return and are placed over a wooden panel into a channel which leads them to the brood stock holding ponds. The selection criteria are based on condition and healthy appearance. Jacks, precocious males less than 12" in length, are not used in mating.

At Lummi Seaponds, broodstock are selected from the returning adults entering the capture pond at the Sea Pond tidegate in the same manner described for Skookum Creek. The selected fish are transferred in oxygenated water to the brood stock holding ponds 1/4 mile away at the Hatchery area.

#### **7.3) Identity.**

All hatchery origin fish are identified by the lack of an adipose fin, or the presence of a CWT or both. Disposition of non-hatchery adults returning to the hatchery will be determined by the Co-Managers in consultation with NMFS.

**7.4) Proposed number to be collected:**

**7.4.1) Program goal (assuming 1:1 sex ratio for adults):**

Annual collection goals at each facility are 800 to 1000 males and 800 to 1000 females

**7.4.2) Broodstock collection levels**

**Skookum Creek Hatchery coho broodstock returnees and eggs received.**

Year	Adults	Females	Males	Jacks	Eggs	Egg Origin(s)
1991	2258	NA	NA	95	7,495,464	On-site, Lummi Bay, Skykomish, Nooksack (Kendall)
1992	3297	NA	NA	1276	1,336,360	On-site
1993	NA	NA	NA	NA	NA	NA
1994	1634	292	1296	567	3,473,736	On-site, Lummi Bay, Nooksack
1995	12291	3391	8612	824	3,985,425	On-site, Lummi Bay
1996	18453	7573	10489	395	1,752,000	Lummi Bay
1997	17893	NA	NA	NA	NA	NA
1998	10082	3156	6642	557	3,300,000	On-site, Lummi Bay
1999	28,827	NA	NA	47	NA	On-site, Lummi Bay
2000						
2001						
2002						

**7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.**

Surplus hatchery-origin adults are sold or donated as food or crab bait, depending on quality of flesh.

**7.6) Fish transportation and holding methods.**

Fish transportation methods are described in sub-section 5.2.

**7.7) Describe fish health maintenance and sanitation procedures applied.**

Consistent with Co-Manager Salmonid Disease Control Policy

**7.8) Disposition of carcasses.**

Surplus hatchery-origin adults are sold or donated as food or crab bait, depending on quality of flesh.

## **SECTION 8. MATING**

**Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.**

**8.1) Selection method.**

Male and female adults entering the trapping facilities are sampled for brood stock throughout the return period using Co-Manager agreed protocols. Selection of spawners is on the basis of ripeness, then size, then at random.

**8.2) Males.**

Skookum Creek -

The milt from 10 males was collected with 2 males in each of 5 plastic cups.

Lummi Bay

The milt from 10 males is collected in a bucket.

**8.3) Fertilization.**

Skookum Creek

In 2002, based on the recommendation of the HSRG, the eggs of 10 females were placed in a 5-gallon bucket and mixed, then equally distributed between 5 one-gallon pails. Each pail was fertilized with the milt from one cup.

Lummi Bay

Eggs from 10 females are collected in a bucket and mixed with the sperm from 10 males.

Fertilized eggs are water hardened and treated with a 5% iodine solution in the spawning buckets to reduce disease incidence

**8.4) Cryo-preserved gametes.**

There are no cryo-preserved gametes used in the program.

**8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.**

Not applicable, as only hatchery-origin stock will contribute to the hatchery spawning population

## **SECTION 9. INCUBATION AND REARING**

**Specify any management *goals* (e.g. “egg to smolt survival”) that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.**

### **9.1) Incubation:**

#### **9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.**

Skookum Creek Hatchery - 1.5 million - 70% to smolt

Lummi Seaponds Hatchery - 1.5 million - 70% to smolt

#### **9.1.2) Cause for, and disposition of surplus egg takes.**

Egg takes of 1.5 million are taken in each hatchery to provide a mortality buffer through the smolt stage.

#### **9.1.3) Loading densities applied during incubation.**

Coho green eggs, weighing 1800-2200/ lb., are loaded at the rate of 160,000 per NoPad tray, well below the manufacturer’s recommended maximum of 360,000 green eggs. Well water is circulated at a minimum of 8 gpm through each tray.

#### **9.1.4) Incubation conditions.**

Well water with saturated dissolved oxygen is used at both facilities. Temperatures are approximately 48-50 degrees F.

#### **9.1.5) Ponding**

Hatchery coho eggs take 280 –480 cumulative temperature units to hatch. Fry are ponded when they are 75% “buttoned up”. Fry weigh 1,800 to 2,100/lb at ponding; they are not measured for length. Swim up is volitional through the NoPad substrate, but ponding is forced.

#### **9.1.6) Fish health maintenance and monitoring.**

Eggs are visually monitored several times daily. Water temperature is constant at 48-50° F. Dissolved oxygen is measured twice daily; given the well water source, there are no silt management procedures necessary for either influent or effluent. Eggs receive no treatment until they are eyed. At that time, they are physically shocked by siphoning and dead eggs are removed by hand or machine (Gen-Sorter, Eugene, OR).

Following shocking, eggs fertilized at the Sandy Point facility are transferred to

Skookum Creek Hatchery for incubation and hatching.

**9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.**

The Skookum Creek Hatchery is not currently incubating or otherwise propagating a listed species.

**9.2) Rearing:**

**9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.**

Fry to smolt = 94- 96% [stage mortality = 4-6%].

**9.2.2) Density and loading criteria (goals and actual levels).**

Flow index target of 1.2 lbs./gpm/inch for fry and fingerlings. The targets are difficult to meet when the fry are in the outside raceways and the water temperature is above 45 degrees F.

**9.2.3) Fish rearing conditions**

All eggs from both Skookum Creek and Lummi Bay are incubated and hatched in separate facilities at Skookum Creek. "Buttoned up" coho fry are weighed (approx. 1,600-2,100/lb) and transferred from the incubation facility to one of twelve 90' x 10' x 3', 22,642 gallon concrete raceways for initial rearing. Each raceway has 2,316 cu. feet rearing space and can hold 175,000 fry.

Fry are fed at the rate of 2% feed per body weight per day.

At 250 to 300 fish/lb., fingerlings are marked and/or CWT and marked with an adipose fin clip, and are transferred to one of four 50' x 325' asphalt lined rearing and acclimation ponds holding approximately 10,900 gallons of water.

Rearing ponds at Skookum Creek hatchery are principally supplied with Skookum Creek water. The water from the creek is processed through two settlement ponds to remove suspended sediments, and is then distributed to rearing facilities. During low flow periods in late summer Skookum Creek water may be supplemented by well water as needed.

Rearing ponds are equipped with pumps to permit recirculation and aeration, if needed. Ponds are netted to prevent predation by birds.

Final rearing and acclimation of the Lummi Bay production takes place in net enclosures in the southwest corner of the Lummi Bay Sea Pond near the tide gates to ensure adequate flushing and aeration with the ebb and flow of the tides

**9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.**

Information is being developed.

**9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.**

Information is being developed.

**9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).**

Moore and Clark dry pelleted food is fed on demand at about 2% of body weight per day.

**9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.**

The Skookum Creek Hatchery is signatory to the “Fish Disease Control Policy (1998)” developed by the Fisheries Co-Managers of Washington State. The hatchery is one of several hatchery facilities in the Nooksack Fish Health Management Zone (FHMZ). FHMZ’s are defined as: “*a geographic area containing one or more watersheds draining into the same bay or estuary from the transfer of live fish, eggs, or gametes are regulated. All surface water supplied facilities located within the FHMZ are included in the FHMZ*”.

A subset of 60 to 120 adult broodstock are sampled for viral and bacterial pathogens at spawning time. Additionally, eggs and fry are sub-sampled on a monthly basis. Sampling procedures are as specified in the Fish Disease Control Policy. Northwest Indian Fisheries Commission (NWIFC) pathologists perform the sampling. Specimens are sent to contract laboratories for analyses.

Two bacterial pathogens are regularly detected: Cold Water Disease (*Flavobacterium psychrophylus*) and Bacterial Kidney Disease (BKD, *Renibacterium salmoninarum*). BKD may be vertically transmitted from female to offspring. Cold water disease is treated with Terramycin medicated feed. BKD is treated with erythromycin medicated feed, or, injecting female broodstock with erythromycin 30 days prior to spawning (only practical at Lummi Bay Sea Ponds).

Sanitation procedures are discussed in Sections 7.7 and 8.3.

**9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.**

Smolt development indices are not currently measured.

**9.2.9) Indicate the use of "natural" rearing methods as applied in the program.**

There are currently no "natural" rearing methods applied in this program, but projects evaluating the effectiveness of these methods are being monitored.

The four large rearing ponds for yearlings are located near a wooded property boundary. Significant amounts of litter and insect fall into these ponds allow natural food benefits.

Natural emigration behaviors are promoted when smolts are volitionally released from rearing ponds.

**9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.**

The Skookum Creek Hatchery is not currently propagating a listed species.

**SECTION 10. RELEASE**

**Describe fish release levels, and release practices applied through the hatchery program.**

**10.1) Proposed fish release levels.**

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs	0			
Unfed Fry	0			
Fry	0			
Fingerling	0			
Yearling	1,000,000	16-20/lb	mid May to mid	Nooksack River
	1,000,000	16-20/lb	June	Lummi Bay

**10.2) Specific location(s) of proposed release(s).**

Release site 1: Skookum Creek Hatchery; South Fork Nooksack RM 14.3, Township 37N, Range 5 East, Whatcom County, WRIA 1.

Release site 2: Lummi Bay Sea Ponds. Lummi Bay, Puget Sound; Township 38N, Range 1

East, Whatcom County, WRIA 1.

### 10.3) Actual numbers and sizes of fish released by age class through the program.

Fish released from Skookum Creek Hatchery.

Release year	Species	Stock <sup>i</sup> Origin	Plant Location	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1989	Coho	SK/LB	Fry off-site SF basin, yearlings on-site	60,000	1,700/lb			1,050,000	18
1990	Coho	SK/LB	On-site			1,321,470	26.5		
1991	Coho	SKY/SKAG	On-site					1,244,915	20
1992	Coho	SK/SKY/NK, LB	Fry off-site NF basin, yearlings on-site	464,490	307			2,214,990	18
1993	Coho	SK/SKY	On-site					1,800,000	18
1994	Coho	SK	On-site			1,900,000	34		
1995	Coho	SK	On-site					1,750,000	18
1996	Coho	SK	On-site					950,000	23
1997	Coho	SK	On-site					1,050,125	20
1998	Coho	SK	On-site					2,321,537	21

Stock abbreviations: SF = South Fork Nooksack, NK = North Fork Nooksack, MF = Middle Fork Nooksack, SK = Skookum Creek (hatchery mix), LB = Lummi Bay, SAM = Samish, GR = Green River, SKAG = Skagit, SKY = Skykomish, BKR = Baker River, MAR = Maritime Park, CLARK = Clark Cr. (Skagit trib.), SOOS = Soos Cr. (Green R., trib.), QUIL = Quilcene R., DUNG = Dungeness R. SNO = Snohomish R.

Fish released from Lummi Bay Hatchery; coho are initially reared at Skookum Creek Hatchery.

Release year	Species	Stock <sup>i</sup> Origin	Plant Location	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988	Coho	LB/SKAG/SKY	Kwina Slough (fry), On-site	46,400	1400/lb			1,006,000	17/lb
1989	Coho	LB/CLARK	On-site					837,800	20
1990	Coho	LB/SK/ <u>WALC</u>	On-site					14,782	15
1991	Coho	SKAG/SKY	On-site					1,260,901	16

Release year	Species	Stock <sup>i</sup> Origin	Plant Location	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1992	Coho	LB/CLARK	On-site			1,347,232	27		
1993	Coho	LB/NK/SKY	On-site					1,320,000	17
1994	Coho	LB	On-site			1,500,000	30		
1995	Coho							1,185,000	NA
1996	Coho							897,700	NA
1997	Coho							1,218,448	NA
1998	Coho							1,197,000	NA
1999									

Stock abbreviations: SF = South Fork Nooksack, NF = North Fork Nooksack, MF = Middle Fork Nooksack, NK = Nooksack R., SK = Skookum Creek (hatchery mix), LB = Lummi Bay, SAM = Samish, KEND = Kendall Hatchery, GR = Green River, SKAG = Skagit, SKY = Skykomish, BKR = Baker River, MAR = Maritime Park, CLARK = Clark Cr. (Skagit trib.), SOOS = Soos Cr. (Green R., trib.), QUIL = Quilcene R., DUNG = Dungenous R. SNO = Snohomish R., WALC = Wallace R.

#### 10.4) Actual dates of release and description of release protocols.

Yearling coho are released volitionally over a 2-week period, usually beginning in mid- May. Volitional release begins when fish go off feed, begin to circle the rearing pond or pen, and crowd the exit flume screen. After two-to-three waves of volitional exit, the remaining fish (about 3-5%) are forced out the exit flume.

The primary advantage is that released fish have undergone initial phases of smoltification and are behaviorally oriented to leave the river system.

**10.5) Fish transportation procedures, if applicable.**

Fish transportation procedures are discussed in Sections 5.2 and 7.6.)

**10.6 Acclimation procedures.**

One half of the Skookum Creek Hatchery coho smolt crop is transferred to the Lummi Sea Pond facility in mid-April. Smolts acclimate in the salt-water sea ponds for approximately 6 weeks and then are volitionally released into marine waters. The objective of sea pond acclimation is to imprint returning spawners to an out-of-river site.

**10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.**

The Lummi Nation instituted a Code Wire Tag (CWT) program at Skookum Creek Hatchery in 1973. CWT fish were also adipose fin-clipped so that they were readily identifiable in fisheries and other points of collection. Total number of CWT fish ranged from 15,000 to 134,000 through 1999, and between 1 and 36 percent of the released crop. Due to a lack of funding, no fish were tagged in brood years 1980-1983. In recent years the goal has been to mark 10 percent, or 100,000 fingerlings, annually. Under the provisions of the Joint WDFW/Tribal Wild Salmonid Policy (WDFW 1999), beginning in Brood Year 2000 all hatchery salmon have been adipose fin-clipped whether or not they have CWTs.

**10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.**

The situation has not occurred. The adjustments to abundance occur as fry are moved to the rearing ponds.

**10.9) Fish health certification procedures applied pre-release.**

Fish health status is monitored on a monthly basis under a certification program overseen by the NWIFC. Monitoring dates may, or may not, coincide with the immediate pre-release period.

**10.10) Emergency release procedures in response to flooding or water system failure.**

Rearing ponds at the Skookum Creek facility are equipped with re-circulation pumps that are, in turn, provided with emergency power.

Smolts at the Lummi Bay facility are in marine water, and in certain emergencies have been released early.

**10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.**

The coho program does not involve listed fish.



## **SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS**

### **1.1) Monitoring and evaluation of “Performance Indicators” presented in Section 1.10.**

#### **11.1.1) Describe plans and methods proposed to collect data necessary to respond to each “Performance Indicator” identified for the program.**

##### **(a) Contributions to Fisheries**

Skookum Creek and Lummi Bay coho production is Coded Wire Tagged as a Pacific Salmon Treaty Indicator Stock Program and under that program all fisheries in the treaty area are sampled to determine contributions of indicator stocks. Lummi Natural Resources has instituted programs to improve the monitoring of tribal fisheries in the area of the reservation to allow the identification of contributions to the tribal fisheries in and around the reservation which is not possible under the current co-manager programs. Lummi will analyze available data in consultation with co-managers, to provide the best estimates of the contributions to all fisheries.

##### **(b) By-Catch of Listed Fish**

The co-manager fisheries sampling program under PST indicator stock program will provide estimates of the numbers of listed fish taken in fisheries directed at Skookum Creek and Lummi Bay programs.

##### **(c) Hatchery Brood Stock Goals**

Standard Operating Procedures require processing all the fish entering the trapping facilities to identify species, sex, marks and age of all species on a regular basis depending on the numbers of fish entering. Brood stock is selected and surplus culled. Data will be totaled and maintained in a database.

##### **(d) Hatchery Release Goals**

Standard Operating Procedures require the best possible estimate of the number of smolts released.

Skookum Creek currently estimates the numbers of yearlings in the pond prior to opening the gates by subtraction of mortalities from the numbers placed in the pond when they are transferred from the raceways. The value of this estimate has been validated by occasional electric monitoring and comparison with the difference between estimates of fish transferred to the Lummi Bay facility to the numbers placed in the pond during the fry transfer.

The numbers Lummi Bay brood fingerlings transferred from Skookum Creek rearing facilities are estimated volumetrically at the time of transfer from the ponds to the transport truck. The release numbers is determined after subtraction of mortalities after the

fish are placed in the netted enclosures in the Sea Ponds.

**(e) Stock integrity and Genetic Diversity**

Spawner selection and fertilization will follow protocols developed from the best available science to ensure the viability of the brood stock.

**(f) Maximize Production Efficiencies**

Standard Operating Procedures require regular monitoring of conditions during all phases of the hatchery operations. Records of growth, numbers, mortalities, fish health and water quality parameters are tabulated and reviewed to associate effects with causes and identify options to increase production efficiencies.

**(g) Minimize Interactions with Listed Fish**

**i Limit Pathogen Transfer**

Fish health is monitored on a regular basis and preventative measures and strategies to maintain fish health are implemented and health problems are treated in a timely manner to prevent entry of pathogens in to the fish populations outside of the hatchery.

**ii Co-occurrence during seaward migration**

The co-occurrence of natural origin and cultured coho and juvenile chinook of cultured and natural origin during the movements down river will be estimated at screw traps during the smolt migrations located near the confluence of the South Fork and the Mainstem Nooksack River, (Nooksack Natural Resources) and at the upper limit of the tidal influence in the Mainstem Nooksack River (Lummi Natural Resources)

**iii Co-occurrence during river residence**

Co-occurrence during the period of river migration will be investigated as part of the baseline studies by Lummi Natural Resources on the salmonid distribution in the Acme-Saxon Reach of the South Fork Nooksack River. During the period of the movement of the smolts out of the Skookum Creek facility the relative proportion of the natural origin, and cultured origin coho and natural origin chinook will be estimated and the stomach contents of the natural origin, and cultured origin coho will be examined for the presence of chinook.

**iv Co-occurrence during estuary and near shore habitat**

Co-occurrence during the period of transition from the fluvial to the marine habitats will be investigated as part of the studies by Lummi Natural Resources on the delta of the Nooksack River and the adjacent near shore marine habitats from

Neptune Beach to Post Point. A combination of gears will non-lethally sample habitats in the region for salmonid fish distribution and abundance. Co-occurrence of this natural origin coho will be determined based on the presence or absence of adipose fins on the coho examined. Co-occurrence with chinook will also be estimated on the basis of coho fin clips.

**v Predation of Cultured Coho on Listed Fish**

Coho collected during sampling operations in the Acme Saxon reach of the South Fork Nooksack River, smolt trap operation at the upper end of the tidal bore, or in the transitional habitats from the river to the ocean will be sampled periodically by non-lethal methods to determine whether listed fish form part of the diet of the cultured coho identified by the absence of adipose fins.

**(h) Meet Water Quality Standards**

Requirements of NPDES permits will be met by water quality monitoring or best management practices as required.

**(i) Monitor Stray Rates.**

Co-manager spawning ground surveys in the South Fork Nooksack River will be expanded as resources allow and samples of the carcasses will allow an estimate of the proportions of cultured and natural origin coho on the spawning grounds.

Coho taken in the Lummi River fishery will be examined for the presence and absence of adipose fins. The ratio of the marked and un marked fish in the river fishery will be monitored and may lead to a better estimate of the natural origin coho in the system. Coho tissues from un marked fish will be collected and inventoried for DNA analysis as resources become available.

**11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.**

The funding, staffing and other support logistics are available and committed to allow implementation of the monitoring and evaluation program. While resources are always in short supply, the basic program can be implemented. LNR aggressively seeks funds to ensure that the best available science is available to meet its broad mandate to protect treaty reserved resources, which include salmonid resources of the Nooksack Basin, and ensure sustainable fisheries according to cultural tradition, conservation principles and applicable court orders and Federal Laws.

**11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.**

Studies are designed to avoid protocols with proven high risk for direct take (e.g., electro-fishing, gillnetting), whenever possible. Additionally, those protocols that do involve handling listed fish, are designed to minimize stress.

- Smolt Traps - Operations will be staffed to ensure that live boxes are kept clear of debris and emptied regularly to minimize stress. Protocols for the handling of have a demonstrated ability to have a limited effect on the fish.
- Nooksack Basin Spawner Surveys. The spawning ground surveys are conducted according to agreed co-manager protocols which are regularly evaluated and modified to ensure the best available resource information with a minimum on impact on the fish being surveyed. Redds are avoided and spawning and holding fish are not to be disturbed.
- Other Monitoring and Research.

Other monitoring and research activities will have protocols developed in consultation with the National Marine Fisheries Service to minimize risk for impact to listed species

## **SECTION 12. RESEARCH**

There are many unknowns concerning the effect of hatchery production on the viability of natural salmonid populations. Lummi is committed to applying the best available science to this problem. Where information is conclusive modifications to the program will be taken to ensure that the best available science is implemented consistent with treaty rights and available resources. In the absence of conclusive evidence of adverse impacts of cultured coho on natural origin coho, chinook or bull trout or other species of concern, Lummi will seek to generate the information required to meet plan objectives.

## **SECTION 13. ATTACHMENTS AND CITATIONS**

*Include all references cited in the HGMP. In particular, indicate hatchery databases used to provide data for each section. Include electronic links to the hatchery databases used (if feasible), or to the staff person responsible for maintaining the hatchery database referenced (indicate email address). Attach or cite (where commonly available) relevant reports that describe the hatchery operation and impacts on the listed species or its critical habitat. Include any EISs, EAs, Biological Assessments, benefit/risk assessments, or other analysis or plans that provide pertinent background information to facilitate evaluation of the HGMP.*

This section is under development.

**SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY**

**“I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973.”**

Name, Title, and Signature of Applicant:

Certified by \_\_\_\_\_ Date: \_\_\_\_\_

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